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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/789,810	02/27/2004	Evgueni Goldberg	CA7031042001	5639
23639 7590 05/11/2007 BINGHAM MCCUTCHEN LLP Three Embarcadero Center San Francisco, CA 94111-4067			EXAMINER FERNANDEZ RIVAS, OMAR F	
			ART UNIT 2129	PAPER NUMBER
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/789,810	<b>Applicant(s)</b> GOLDBERG ET AL.	
	<b>Examiner</b> Omar F. Fernández Rivas	<b>Art Unit</b> 2129	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☒ Responsive to communication(s) filed on 26 March 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 1-56 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-56 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 01 October 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)            | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | Paper No(s)/Mail Date. _____                                      |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>10/12/2006</u>  | 6) <input type="checkbox"/> Other: _____                          |

### DETAILED ACTION

1. This Office Action is in response to an RCE filed by the Applicant entered on March 26, 2007.
2. The Office Action of December 26, 2006 and May 4, 2006 are incorporated into this Non-Final Office Action by reference.

### *Status of Claims*

3. Claims 1, 31 and 41 have been amended. Claims 1-56 are pending on this application.

### *Claim Rejections - 35 USC § 103*

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-7, 9-17, 21, 24,26-29, 31-37, 39-47, 49-50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Marques-Silva et al. in view of Moskewicz et al. ("GRASP: A Search Algorithm for Propositional Satisfiability", referred to as **Marques-Silva**; "Chaff: Engineering an Efficient SAT Solver", referred to as **Moskewicz**).

### **Claims 1, 31 and 41**

Marques-Silva teaches a method of solving satisfiability problems, the method comprising: a) organizing a plurality of clauses in a satisfiability problem as a chronologically ordered structure comprising a top and a bottom, wherein newly

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deduced conflict clauses are added to the top of the structure; b) selecting a branching variable from a plurality of unassigned variables in the satisfiability problem; c) assigning value 0 or 1 to the selected branching variable; d) marking literals set to 0 e) invoking Boolean Constraint Propagation when the structure comprises one or more unit clauses; (f) repeating (b)-(e) when the structure only comprises one or more non-unit clauses; g) returning a solution if a solution is found (**Marques-Silva**: Page 508, Section 2.4; page 509, Section 2.5 and Fig 2; Examiner's note (EN): paragraph 10 applies. All of the steps described above are disclosed in the sections cited above and in the algorithm of figure 2. The search tree is an ordered structure, the search function will select the branching variable, an assignment of 0 or 1 will be given to the variable, variables are literals (**Marques-Silva**: Section 2.1, L1-5) and the algorithm will return "success" if a solution is found).

Marques-Silva does not teach maintaining individual activity counters for variables in the plurality of clauses, wherein the individual activity counters are based upon clauses that are involved with a conflict and in which the branching variable is selected by selecting a clause and an active variable from the clause based upon the activity counter.

Moskewicz teaches maintaining individual activity counters for variables in the plurality of clauses, wherein the individual activity counters are based upon clauses that are involved with a conflict and in which the branching variable is selected by selecting a clause and an active variable from the clause based upon the activity counter.

(**Moskewicz**: page 531, Section 2, L5-45; page 532, C1, L44 to C2, L11; EN: paragraph

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10 applies. The literal count for the conflict clauses will be dominant; therefore the counter for the literals will depend (be based) on the literals (variables) in conflict clauses. The variable with the highest counter is chosen).

It would have been obvious to one of ordinary skill in the arts at the time of the applicant's invention to modify the teachings of Marques-Silva by incorporating maintaining individual activity counters for variables in the plurality of clauses, wherein the individual activity counters are based upon clauses that are involved with a conflict and in which the branching variable is selected by selecting a clause and an active variable from the clause based upon the activity counter as taught by Mosewicz for the purpose of having means to branch to the clauses in conflict so that the conflicts can be resolved to obtain a satisfactory result to the problem.

#### **Claims 2, 32 and 42**

Marques-Silva teaches the structure comprises at least one initial clause (**Marques-Silva**: Section 2.4, page 508; EN: the Examiner reads "w" as the initial clause) and at least one conflict clause (**Marques-Silva**: Section 3, page 509; EN: the Examiner reads "wc(k)" as the conflict clause).

#### **Claims 3, 33 and 43**

Marques-Silva teaches at least one initial clause is located below the at least one conflict clause in the structure (The initial clause is below the conflict clause because the initial clause is in the database (structure) before a conflict arise).

**Claims 4, 34 and 44**

Marques-Silva teaches the branching variable is selected from among a set of unassigned variables in the clause on top of the structure when the top clause is a conflict clause (**Marques-Silva**: Section 2.5, page 509; EN: the Examiner reads that the branching variable is selected using the Search function).

**Claims 5, 35 and 45**

Marques-Silva does not teach maintaining an activity counter for each unassigned variable.

Moskewicz teaches maintaining an activity counter for each unassigned variable (**Moskewicz**: page 531, Section 2, L5-45; page 532, C1, L44 to C2, L11).

It would have been obvious to one of ordinary skill in the arts at the time of the applicant's invention to modify the teachings of Marques-Silva by incorporating maintaining an activity counter for each unassigned variable as taught by Moskewicz for the purpose of having means to determine the changes in the assignment of a variable in a clause.

**Claims 6, 36 and 46**

Marques-Silva teaches does not teach the activity counter of an unassigned variable is incremented each time the unassigned variable appears in a clause used when generating a conflict clause.

Moskewicz teaches the activity counter of an unassigned variable is incremented each time the unassigned variable appears in a clause used when generating a conflict clause (**Moskewicz**: page 531, Section 2, L5-45; page 532, C1, L44 to C2, L11).

It would have been obvious to one of ordinary skill in the arts at the time of the applicant's invention to modify the teachings of Marques-Silva by incorporating incrementing the activity counter of an unassigned variable each time the unassigned variable appears in a clause used when generating a conflict clause as taught by Moskewicz for the purpose of having means to determine how much a given variable contributes to generating a conflict in a clause.

**Claims 7, 37 and 47**

Marques-Silva does not teach the selected branching variable composes an activity counter, with the highest value.

Moskewicz teaches the selected branching variable composes an activity counter, with the highest value (**Moskewicz**: page 531, Section 2, L5-45; page 532, C1, L44 to C2, L11; EN: choosing the variable with the highest counter in each decision)

It would have been obvious to one of ordinary skill in the arts at the time of the applicant's invention to modify the teachings of Marques-Silva by incorporating the selected branching variable composes an activity counter, with the highest value as taught by Moskewicz for the purpose of selecting the branch variable based on the variable that occurs more frequently in a clause.

**Claims 8, 38 and 48**

As per claims 8, 38 and 48 Marques-Silva does not teach the activity counters are periodically divided by a constant greater than one.

Moskewicz teaches the activity counters are periodically divided by a constant greater than one (**Moskewicz**: page 531, Section 2, L5-45; page 532, C1, L44 to C2, L11).

It would have been obvious to one of ordinary skill in the arts at the time of the applicant's invention to modify the teachings of Marques-Silva by incorporating the activity counters are periodically divided by a constant greater than one as taught by Moskewicz for the purpose of having means to determine the influence of a variable in a conflict clause.

#### **Claims 9, 39 and 49**

Marques-Silva teaches whether 0 or 1 is assigned to the selected branching variable depends upon costs associated with the positive and negative literals of this variable (**Marques-Silva**: page 507, Section 2.1; EN: the value of the formula  $\varphi$  is a cost. The values are assigned to the variables).

#### **Claims 10, 40 and 50**

Marques-Silva teaches the cost of a literal is equal to the total number of conflict clauses containing the literal (**Marques-Silva**: page 507, Section 2.1).

#### **Claim 11**

Marques-Silva teaches the cost of a literal is equal to the total number of binary clauses containing the literal plus; for each binary clause containing the literal, the total number of binary clauses containing an opposite of the other literal in the binary clause (**Marques-Silva**: page 509, Section 2.1; EN: the Examiner reads that the literal is the occurrence of a variable or its complement, which is the opposite).



**Claim 12**

Marques-Silva teaches if there is at least one unsatisfied conflict clause, the selected branching variable is assigned value 1 if the cost associated with the positive literal of this variable is higher than the cost associated with the negative literal (Marques-Silva: Marques-Silva: page 507, Section 2.1; Fig. 3; EN: the Examiner reads that "x" can either be set to 1 or 0).

**Claim 13**

Marques-Silva teaches if there is at least one unsatisfied conflict clause, the selected branching variable is assigned value 0 if the cost associated with the negative literal of this variable is higher than the cost associated with the positive literal (Marques-Silva: Marques-Silva: page 507, Section 2.1; Fig. 3; EN: the Examiner reads that "x" can either be set to 1 or zero).

**Claim 14**

Marques- Silva teaches if all conflict clauses are satisfied, the selected branching variable is assigned value 0 if the cost associated with the positive literal of this variable is higher than the cost associated with the negative literal (Marques-Silva: Marques-Silva: page 507, Section 2.1; Fig. 3; EN: the Examiner reads that "x "can either be set to 1 or zero).

**Claim 15**

Marques-Silva teaches if all conflict clauses are satisfied, the selected branching variable is assigned value 1 if the cost associated with the negative literal of this variable is higher than the cost associated with the positive literal (Marques-Silva:

**Marques-Silva:** page 507, Section 2.1; Fig. 3; EN: the Examiner reads that "x" can either be set to 1 or zero).

**Claim 16**

Marques-Silva teaches maintaining an activity counter for each conflict clause (**Marques-Silva:** page 509, Section 2.5, L45-50; page 511, Fig. 2; EN: paragraph 10 applies. The Examiner reads "d" as the counter because it keeps track of the decision level and it is incremented when the clause database is updated) removing one or more conflict clauses from the structure (**Marques-Silva:** Fig 2; EN: the code presented in figure 2 has an Erase function).

**Claim 17**

Marques-Silva teaches the activity counter of a conflict clause is incremented each time the conflict clause is used when generating another conflict clause (**Marques-Silva:** page 509, Section 2.5, L45-50; page 511, Fig. 2; EN: incrementing the value of d).

**Claim 18**

Marques-Silva teaches at least one of the one or more conflict clauses removed from the structure is near the bottom of the structure (**Marques-Silva:** pages 507 and 508, section 2.2; page 510 Section 3.1; EN: traversing the search tree. The clause is erased at the current decision level which depending on the current decision level could be at the bottom of the structure).

**Claim 19**

Marques-Silva teaches at least one removed conflict clause comprises more than eight literals (**Marques-Silva**: page 507, Section 2.1; EN: each clause can contain one or more literals).

**Claim 20**

Marques-Silva teaches at least one removed conflict clause comprises an activity counter with a value less than sixty (**Marques-Silva**: page 509, Section 2.5, L43-50; page 511, Fig. 2; EN: the assignments are deleted at the current decision level d, which could be less than sixty).

**Claim 21**

Marques-Silva teaches at least one of the one or more conflict clauses removed from the structure is near the top of the structure (**Marques-Silva**: Section 3.1, page 510; EN: the Examiner reads that a conflict clause database is augmented with the clause database and the clause is erased at the current decision level which could be near the top).

**Claim 22**

Marques-Silva teaches at least one removed conflict clause comprises more than forty-two literals (**Marques-Silva**: page 507, Section 2.1; EN: each clause can contain one or more literals).

**Claim 23**

Marques-Silva does not teach at least one removed conflict clause comprises an activity counter with a value less than seven (**Marques-Silva**: page 509, Section 2.5,

L43-50; page 511, Fig. 2; EN: the assignments are deleted at the current decision level d, which could be less than seven).

**Claim 24**

Marques-Silva teaches the one or more unsatisfied conflict clauses removed from the structure do not include the clause at the top of the structure (**Marques-Silva**: Page, 511, Fig 2; EN: the Examiner reads that during the backtracking phase, the top conflict is never removed because the search process backtracks to the preceding level "B-1 ").

**Claim 26**

Marques-Silva teaches the top conflict clause of the structure is never removed (**Marques-Silva**: Page, 511, Fig 2; EN: the Examiner reads that during the backtracking phase, the top conflict is never removed because the search process backtracks to the preceding level "B-1 ").

**Claim 27**

Marques-Silva teaches a) invoking reverse Boolean Constraint Propagation when a conflict arises; b) deducing a new conflict clause (**Marques-Silva**: page 508 Section 2.4 to page 509, Section 3); c) returning the answer "no solution" if this clause is empty or adding the newly deduced conflict clause to the top of the structure otherwise (**Marques-Silva**: page 508 Section 2.4 to page 509, Section 3; Fig. 2; EN: The Examiner reads Figure 2 as code that describes the steps presented above. Returning failure is returning no solution).

**Claim 28**

Marques-Silva teaches a conflict arises when all literals in one of the plurality of clauses are set to 0 as a result of one or more assignments of value.

Moskewicz teaches a conflict arises when all literals in one of the plurality of clauses are set to 0 as a result of one or more assignments of value (**Moskewicz**: page 530, C2, L40 to page 531, L13; EN: if all of the literals are set to 0, f will be unsatisfactory and generate a conflict).

It would have been obvious to one of ordinary skill in the arts at the time of the applicant's invention to modify the teachings of Marques-Silva by incorporating a conflict arises when all literals in one of the plurality of clauses are set to 0 as a result of one or more assignments of value as taught by Moskewicz for the purpose of determining if changing the value of a literal will prevent the method from finding a satisfactory solution to the problem.

**Claim 29**

Marques-Silva teaches back tracking is nonchronological (**Marques-Silva**: page 508, section 2.3, item b; page 511, C2, L1-5).

**Claim 30**

Marques- Silva teaches starting a new search tree when more than a threshold number of conflict clauses have been deduced or more than a threshold number of unit conflict clauses have been deduced (Looking at Figure 2, If a conflict arises, the erase function gets called, and the process starts over again, therefore a new search has been invoked on a new tree).

**Claims 51, 52 and 53**

Marques-Silva teaches the structure comprises either a stack or a queue (The Examiner considers that the clause database can be configured to behave as either a stack or a queue).

***Claim Rejections - 35 USC § 103***

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Marques-Silva as set forth above in view of Bayardo et al. ("GRASP: A Search Algorithm for Propositional Satisfiability", referred to as **Marques-Silva**; "Using CSP Look-Back Techniques to Solve Real-World SAT Instances", referred to as **Bayardo**).

**Claim 25**

Marques-Silva does not teach no less than a specified percentage of the conflicts in the structure are removed.

Bayardo teaches no less than a specified percentage of the conflicts in the structure are removed (**Bayardo**; page 204, C2, L15-31).

It would have been obvious to one of ordinary skill in the arts at the time of the applicant's invention to modify the teachings of Marques-Silva by incorporating no less than a specified percentage of the conflicts in the structure are removed as taught by

Bayardo for the purpose of removing the necessary conflicts in the structure to obtain a satisfactory result

***Claim Rejections - 35 USC § 103***

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 54-56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Marques-Silva in view of Moskewicz as set forth above and further in view of Biere et al. ("Symbolic Model Checking Using SAT Procedures Instead of BDD's", referred to as **Biere**).

**Claims 54-56**

Marques-Silva and Moskewicz do not teach the solution is applied for a circuit design undergoing synthesis, test pattern generation or verification.

Biere teaches the solution is applied for a circuit design undergoing synthesis, test pattern generation or verification (**Biere**: page 317, abstract; pages 318-319, Sections 3 and 4.1).

It would have been obvious to one of ordinary skill in the arts at the time of the applicant's invention to modify the combined teachings of Marques-Silva and Moskewicz by incorporating applying the solution to a circuit design undergoing

synthesis, test pattern generation or verification as taught by Biere for the purpose of taking advantage of the efficiency of the of the algorithm in handling Boolean expressions to detect errors in the circuit model since most of these models are described using Boolean expressions (**Biere**: page 317, Introduction, L1-17).

### **Examination Considerations**

7. The claims and only the claims form the metes and bounds of the invention.

"Office personnel are to give the claims their broadest reasonable interpretation in light of the supporting disclosure. In re Morris, 127 F.3d 1048, 105455, 44USPQ2d 1023, 1027-28 (Fed. Cir. 1997). Limitations appearing in the specification but not recited in the claim are not read into the claim. In re Prater, 415 F.2d, 1393, 1404-05, 162 USPQ 541, 550-551 (CCPA 1969)" (MPEP p 2100-8, c 2, I 45-48; p 2100-9, c 1, I 1-4). The Examiner has full latitude to interpret each claim in the broadest reasonable sense. Examiner will reference prior art using terminology familiar to one of ordinary skill in the art. Such an approach is broad in concept and can be either explicit or implicit in meaning.

8. Examiner's Notes are provided with the cited references to prior art to assist the applicant to better understand the nature of the prior art, application of such prior art and, as appropriate, to further indicate other prior art that maybe applied in other office actions. Such comments are entirely consistent with the intent and spirit of compact prosecution. However, and unless otherwise stated, the Examiner's Notes are not prior



art but a link to prior art that one of ordinary skill in the art would find inherently appropriate.

9. Unless otherwise annotated, Examiner's statements are to be interpreted in reference to that of one of ordinary skill in the art. Statements made in reference to the condition of the disclosure constitute, on the face of it, the basis and such would be obvious to one of ordinary skill in the art, establishing thereby an inherent prima facie statement.

10. Examiner's Opinion: The claims and only the claims form the metes and bounds of the invention. The Examiner has full latitude to interpret each claim in the broadest reasonable sense.

### ***Conclusion***

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Franco et al. US Patent #6,912,700

Walser US Patent #6,031,984

12. Claims 1-56 are rejected.

### ***Correspondence Information***

13. Any inquires concerning this communication or earlier communications from the examiner should be directed to Omar F. Fernández Rivas, who may be reached Monday through Friday, between 8:00 a.m. and 5:00 p.m. EST. or via telephone at (571) 272-2589 or email [omar.fernandezrivas@uspto.gov](mailto:omar.fernandezrivas@uspto.gov).

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If you need to send an Official facsimile transmission, please send it to (571) 273-8300.

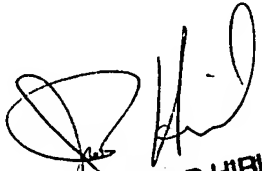
If attempts to reach the examiner are unsuccessful the Examiner's Supervisor, David Vincent, may be reached at (571) 272-3080.

Hand-delivered responses should be delivered to the Receptionist @ (Customer Service Window Randolph Building 401 Dulany Street Alexandria, VA 22313), located on the first floor of the south side of the Randolph Building.

Omar F. Fernández Rivas  
Patent Examiner  
Artificial Intelligence Art Unit 2129  
United States Department of Commerce  
Patent & Trademark Office

Wednesday, May 02, 2007

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